THE RELATIONSHIP BETWEEN CLOSED KINETIC AND OPEN KINETIC CHAIN STRENGTHENING EXERCISE FOR LOWER LIMB EXTENSORS ON JUMPING PERFORMANCE IN COLLEGIATE BASKETBAL PLAYERS

A Dissertation Submitted To

THE TAMILNADU Dr.M.G.R. MEDICAL UNIVERSITY CHENNAI

In partial fulfillment of the requirements for the awards of the

MASTER OF PHYSIOTHERAPY

(SPORTS PHYSIOTHERAPY)

Submitted by

P.VINOTH

Reg. No. 271550081

APRIL - 2017

NANDHA COLLEGE OF PHYSIOTHERAPY

ERODE – 638052

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Dissertation evaluated on …….

Internal Examiner External Examiner

CERTIFICATE BY THE HEAD OF THE INSTITUTION

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Date :

CERTIFICATE BY THE GUIDE

` This is to certify that the dissertation work entitled **"THE RELATIONSHIP BETWEEN CLOSED KINETIC AND OPEN KINETIC CHAIN STRENGTHENING EXERCISE FOR LOWER LIMB EXTENSORS ON JUMPING PERFORMANCE IN COLLEGIATE BASKETBAL PLAYERS"** was carried out under my guidance by **Reg. No. 271550081**, Nandha College of physiotherapy, Erode. Affiliate to THE TAMILNADU Dr. M.G.R.MEDICAL UNIVERSITY, Chennai.

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Date:

DECLARATION

I hereby and present my project work entitled **"THE RELATIONSHIP BETWEEN CLOSED KINETIC AND OPEN KINETIC CHAIN STRENGTHENING EXERCISE FOR LOWER LIMB EXTENSORS ON JUMPING PERFORMANCE IN COLLEGIATE BASKETBAL PLAYERS"** is outcome of original research work was undertaken and carried out by me under the guidance of **Associate. Prof.T. LOGANATHAN, M.P.T (SPORTS)**

To the best of my knowledge this dissertation has not been formed in any other basic for the award of any other degree, diploma, associateship, fellowship, preciously from any other medical university.

Reg.No.271550081

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I am grateful to **GOD**, who by his immeasurable, infinite grace and blessings enabled me to complete this venture.

I wish to express my gratitude to our Principal, **Prof.V.MANIVANNAN, M.P.T (Ortho),** and my guide, **Associate. Prof. T. LOGANATHAN, M.P.T (SPORTS)** for supporting me and giving me much valuable advice at right times throughout the academic period & especially during this research work.

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Last but not the least, I would like to pay my gratitude to **My Family** who always had so much confidence in me and always provided me with a constant silent support, encouragement and inspiration.

PREFACE

It was immense pleasure for me to present this project work on **"THE RELATIONSHIP BETWEEN CLOSED KINETIC AND OPEN KINETIC CHAIN STRENGTHENING EXERCISE FOR LOWER LIMB EXTENSORS ON JUMPING PERFORMANCE IN COLLEGIATE BASKETBAL PLAYERS"** because this opportunity made me learn a lot about this condition.

I have done this work with my best level by referring many sports medicine and orthopedics books, journals and websites. I have assessed and given treatment to patient to improve their condition. I believe this project work will prove to be very useful for the physiotherapists and physiotherapy student to give a better knowledge while assessing & treating orthopedics related conditions.

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INTRODUCTION

Jumping is the form of locomotion familiar to man from childhood, The person should have good jumping capacity as per as basketball players is concerned this necessitates the need of jumping training by the concerned coach for basketball players.

In jumping the player producing vertical velocity, for centre of gravity through plantarflexion in ankle, knee extension, hip extension, trunk head and fore arm movements. Duringtakeoff a key factor is to utilize all positive net impulse effects for a high vertical release velocity of the centre of gravity of player. Timing of the segmental movements is a real skill factor in jumping.

A jump in match conditions can be executed with or without run- up. The take off without run up can start from a squatting position, erect position with counter movement or with preparatory movement by arms. The number of jumps in a match is on average 11-20 in a match.

The real meaning of jumping ability varies according to the game. In basketball, the excellent jumping ability from physical point of view (explosive strength and endurance) is the key factor.

Leaving the complex bio mechanics behind, jumping can be started as an activity, which primarily involves overcoming the inertia with co-ordination of various muscle contraction in the project oneself against the force of gravity.

This study limits itself to effect of open kinetic and closed kinetic training of extensor muscles in lower extremity on jumping performances.

More recently closed kinetic chin exercise and also found a significant positive outcome in vertical jump performance. Authors significant positive correlations between open and closed kinetic chain strength exercise of knee extensors and functional performances.

Closed kinetic exercise is that these exercises results in less anteroposterior shear force at the knee joint, when compared with traditionally used open kinetic chain exercises.

1.1 SIGNIFICANCE OF THE STUDY:

In several study that athletes tolerated closed kinetic chain exercise better than open kinetic chain exercise in functional range of motion because of stress over patella femoral joint.

The significance of the study is to find whether closed kinetic chain exercise or closed kinetic chain exercise is effective in improving vertical jump performance and extensor muscle strength of lower leg.

Uses included:

Improving ankle range of motion and flexibility, rehabilitation of patella femoral pain syndrome athletes, hip and knee injury prevention and strengthening, ACL reconstruction, sensorimotor training, balance proprioception training for lower extremities.

1.2 OBJECTIVE:

To evaluate the most effective strengthening exercise among the two technique (open kinetic chain exercise & closed kinetic chain exercise) in improving vertical jump performance and muscle strength among basketball players.

1.3 HYPOTHESIS:

NULL HYPOTHESIS:

There is no significant difference produced between the two groups in vertical jump performance and lower extremity muscle strength of collegiate basketball players.

ALTERNATIVE HYPOTHESIS:

There is significant difference produced between the two groups in vertical jump performance and lower extremity muscle strength of collegiate basketball players.

1.4 OPERATIONAL DEFINITIONS

CLOSED KINETIC CHAIN EXERCISE

Closed kinetic chain exercises are typically weight bearing movement at several joint is required to complete the movement, the distal segment is usually fixed to a supporting surface and the resistance may be applied both proximally and distally.

OPEN KINETIC CHAIN EXERCISE

Open kinetic chain exercises are typically non weight bearing with movement occurring at a single joint. The distal segment is free to move and the resistance is usually applied to the distal segment.

VERTICAL JUMP PERFORMANCE:

Vertical jump is the ability to raise one centre of gravity higher in the vertical plane solely with the use of s own muscles. It is measure of how high an athlete can elevate off the ground from standstill.

1 REPETITIVE MAXIMUM:

One rep maximum (one repetition maximum or 1 RM) in weight training is the maximum amount of weight one can lift a single repetition for a given repetition for a given exercise. One repetition maximum can also determining an individual's maximum strength. One repetition maximum can also be used as an upper limit, in order to determine the desired "load" for an exercise (as a percentage of the 1RM).

CHAPTER-II
REVIEW OF LITERATURE

SofiTagesson et al (2008) states rehabilitation with open kinetic chain quadriceps exercise led to significantly greater quadriceps strength compared with rehabilitation with closed kinetic quadriceps exercise.

Kevin w mccurdyct al (2008) determined the validity of one RM closed chain loaded for both and women.

Itamal (2006) states that one RM test is considered the gold standard for assessing muscle strength in non-laboratory condition.

Hamada et al (2006) states heavy loading exercise like squat appears in a similar movement pattern of exercise appears to enhance maximal strength and power.

Hoffman (2006) in his research demonstrated that maximal isometric contractions and maximal or near maximal dynamic exercises can augment the rate of force development , increase the vertical jump height.

Luis F. Aragon (2006) on his study of reablity of vertical jump shows a standard improvement of subjects in their performance in both pre and post-test in vertical jump test.

Jay Hoffman. Nicholas A Ratamess (2005) indicates that vertical jump and power performance were significally improved by prior maximal squat performance.

Chiu and colleagues (2003) suggest that recreationally trained individual of athletes may exhibit fatigue within the first 5 min following acute heavy resistance exercises stimulus.

Stensdotteret at (2003) showed that the amplitude of the electromyography (EMG) signal normalized by maximal voluntary contraction of the oblique vastusmedialis (OVM) muscle is greater on CKC, although lower than that of the vastuslateralis muscle in both exercises.

Deharen KE (2002) open kinetic and leg extension exercise have been the traditional means of strengthening the quadriceps.

Arteaga et al (2000) have shown that the variability in the assessment of the jumping performance is similar to that repeated for other variables used in the assessment of physical fitness.

J Auguston and R Thomme et al (1999) suggests that the moderate co relations between tests of muscular strength and vertical jump test indicate that the results of strength measurements cannot be used to adequately assess functional performance.

Negrete RJ, BrophyJ (1999) shown that there is no transfer of isokinetic closed chain strength to the open chain isokinetic closed chain strength to the open chain isokinetic strength of the hip, knee, and ankle musculature.

Greenburger et al (1998) showed a significant position correlation has also been found for OKC isotonic and isokinetic testing of the leg muscles and jumping performance in uninjured subjects.

Blackburn JR, Morrissey MC (1998) similar finding have been obtained when testing the relationship between isotonic squat strength and both vertical-jump and long-jump performance.

Escamilla, Rafael F.et al (1998) states the squat generated approximately twice as much hamstring activity as the leg press and knee extensions. Quadriceps muscle activity was greatest in CKCE when the knee was near full flexion and in OKCE produced more rectus femoris activity while CKCE produced more vasti muscle activity. Tibiofemoral compressive force was greatest in CKCE near full flexion and in OKCE near full extension in the posterior cruciate ligament was approximately twice as great in CKCE, and increased with knee flexion. Tension in the anterior cruciate ligament was present only in OKCE, and occurred near full flexion and in the midrange of the knee extending phase in OKCE.

Wilson et al (1993) in his study used squat test to determine the effects of various training and rehabilitation intervention.

GK Fitzgerald (1996) suggests that open kinetic chain and closed kinetic chain exercise can be applied in manner that minimizes the risk of excessive graft strain and patello femoral compression.

Bynum BE (1996) states that closed kinetic chain are believed to be safer than open kinetic chain because they place less strain on the ACL, Graft.

Cordova et al (1995) found no correlation between changes in non weight bearing closed chain isokinetic strength and changes in single leg jump reaction since after a 5 week closed chain training program.

Davis GJ (1995) the muscular strength defects found in patients who are tested in the open and closed chain isokinetic concentric reciprocal modes.

Andrews (1995) whose findings concurred with ours, demonstrated a significant positive correlation among isokinetic reciprocal knee testing (Biodex: shidey, NY) at 180 and 360 ^{6} / second in 3 different single leg hop tests.

Ashley and Weins (1994) reported significant positive findings between isokinetic squat strength and vertical jump performance

Shelborne KD (1994) suggests several limitations of open kinetic chain exercises exist including isolated knee motions and lack of contraction at the knee.

Edwin E bunton et al (1993) started at closed kinetic chain training is an economical, efficient, and effective means of training with the unlimited goal of enhancing proprioception thus gaining lower extremity joint stability.

Yack et al (1993) examined the amount of anterior tibial displacement during resisted knee extension (open kinetic chain exercise) and during a parallel squat (closed kinetic exercise) in 11 subjects with ACL deficiency

Reynolds et al (1992) reported that a progressive step up protocol without resistance did not increase quadriceps isokinetic peak torque measurements.

Blair DF et al (1991) proposed benefits of closed kinetic chain exercise or co contraction of quadriceps and hamstring muscles functional lower extremity movement using eccentric and concentric contraction at the hip, knee and

ankle, decreased anterior translation of tibia on femur and decreased elongation force on the anterior cruciate ligament.

Palmitier et al (1991) shows protocol incorporated closed kinetic chain activities such as squats, Step ups, for quadriceps strengthening.

JG, DePalma BF, Zelko RR. (1991) states that a review of the literature indicate that closed kinetic chain exercises have a advantages over open kinetic chain exercises.

MATERIALS & METHODOLOGY

MATERIALS

The following equipment's were used in the study in which closed and open kinetic chain exercise Vertical jump performance and gluteal and quadriceps muscle strength of lower leg.

- Quadriceps table.
- Weight plates.
- Inch tape.
- Weightcuff.

METHODOLOGY:

3.1 RESEARCH DESIGN:

Experimental study design.

3. 2 SETTINGS:

Basketball ground, Nandha SPORTS CLUB.

3.2(a) STUDY DURATION

- Study was conducted for a period of 9 months.

3.2(b) TREATMENT DURATION

- 20 minutes per day, days in week for 6 weeks.

3. 3 SAMPLING:

Randomized sampling technique.

3. 4 SELECTION CERTERIA:

INCLUSION CERTERIA:

1. Age group (18-25 years).
2. College athletes.
3. Participants were male basket ball players.

EXCLUSION CERTERIA:

1. History of previous ankle sprains(6 month).
2. History of previous lower extremity injuries.
3. Elite players.
4. Athletes undergoing any strength training programme.

3.5 PROCEDURE:

The informed consent was obtained from all the participants. 30 participants were included in the randomly allocated into two groups. Group A & Group B.

15 participants in Group A were instructed to perform closed kinetic chain exercise for 30seconds with 15 repetitions. Rest period for 10 seconds in between the each exercise.

15 participants in Group B were instructed to perform open kinetic chain exercises for 30seconds with 15 repetitions. Rest period for 10 seconds in between the each exercise.

Vertical jump performance and gluteal and quadriceps muscle strength for 30 participants were measured at the baseline and 6 week of training programme.

GROUP A:

CLOSED KINETIC CHAIN EXERCISES:

1. **Squat up exercise**: Bend knees forward while allowing hips to bend back behind, keeping back straight and knees pointed same direction as feet. Descends until knees and hips are fully bend. Extend knees and hips until legs are straight.
2. **Lungs forwards**: Lungs forward with alternating legs while keeping torso vertical.
3. **Step up exercise**: Can be performed forward, backward, late

Fig. closed kinetic chain exercise (squat)

Fig. closed kinetic chain exercise (lunge forward)

Fig. closed kinetic chain (step up)

GROUP B:

OPEN KINETIC CHAIN EXERCISE:

1.Quadriceps strengthening exercise: Lay out your back on a flat surface. Bend the knees of your uninvolved leg to a 90-degree angle, and keep your foot flat on the surface. Keep your uninvolved leg straight without the knees bent. Slowly lift the involved leg six inches off the floor. Hold for five seconds. Slowly lower your leg to the floor. Relax and repeat 10 more times.

2. Gluteal strengthening exercise: In prone lying, in this position, take 3 seconds to lift your left leg straight behind you without bending your knee, with the weight cuff. Hold the position for 10 seconds. Repeat with right leg.

3.6 OUTCOME MEASURES:

VERTICAL JUMP PERFORMANCE:

`The participant in each group was tested on vertical jump height using sergeant jump test. Chalk powder was applied on the tips of three fingers (index, middle & ring finger) of the participant dominant hand. Without a preparatory step, the participant flexes the knee & quickly lowers the body into a squat position & swings the arms backwards. He then jumps as high as possible, extending the arms. At the highest point, the participant makes a mark. The score is the vertical distance between the 2 chalk marks.

ONE REPETITIVE MAXIMUM:

The participant is asked to lift a fixed weight in his leg from fully extended to raise upwards without knee flexed for gluteus in prone lying, a pelvic strap was placed across the participant's posterior superior iliac spine and around the table during the testing procedure. And the participant is asked to lift a fixed weight in his leg from knee flexed to raise upwards in long sitting in quadriceps table to measure quadriceps strength. The amount of weight was determined participants perception and 1RM was calculated by using the formula,

$$\frac{\text{No of repetition} + 1}{30} \times \text{weight used}$$

Fig. 1RM measurement of quadriceps

Fig. vertical jump performance

Fig. open kinetic chain exercise

(Isometric quadriceps strengthening exercise)

Fig. open kinetic chain exercise (gluteal strengthening exercise)

CHAPTER-IV

STATISTICAL ANALYSIS

The collected data were tabulated & analysed using descriptive & inferential statistics. To all parameters mean & standard deviation were used. Paired t-test was used to analyses significant changes between the groups.

4.1 STATISTICAL METHOD:

For the pre and post test experimental study, both paired and unpaired 't' test was used for each parameter in an intra group analysis to find out the significance of improvement achieved through intervention. Then unpaired 't' test was used to find out the significance of the changes between two groups i.e., inter-group analysis.

4.1(a) **PAIRED 't'-TEST**

To compare the effect between two groups students 't' test for paired values.

Formula for paired t-test

$$S = \frac{\Sigma d^2 - \frac{(\Sigma d)^2}{n}}{n-1}$$

$$t = \frac{\bar{d}\sqrt{n}}{s}$$

d = difference between the pre test and post test

$\bar{d}$ = Mean difference

n = Total number of subjects

S = Standard deviation

4.1(b) UNPAIRED t- TEST

The unpaired t-test was used to compare the effects between two groups, students‘t’ test for unpaired values

Formula unpaired t –test

$$S = \sqrt{\frac{(n_1-1){s_1}^2+(n_2-1){s_2}^2}{n_1+n_2-2}}$$

$$t = \frac{|\bar{x}_1-\bar{x}_2|}{s\sqrt{\frac{1}{n_1}+\frac{1}{n2}}}$$

n_1 = Total number of subjects in Experimental Group.

n_2 = Total number of subjects in Control Group.

$\overline{X_1}$ = Mean difference between pre test and post test of Experimental group.

$\bar{X}_2$ = Mean difference between pre test and post test of Control Group.

S_1 = Difference between pre test and post test of Experimental Group.

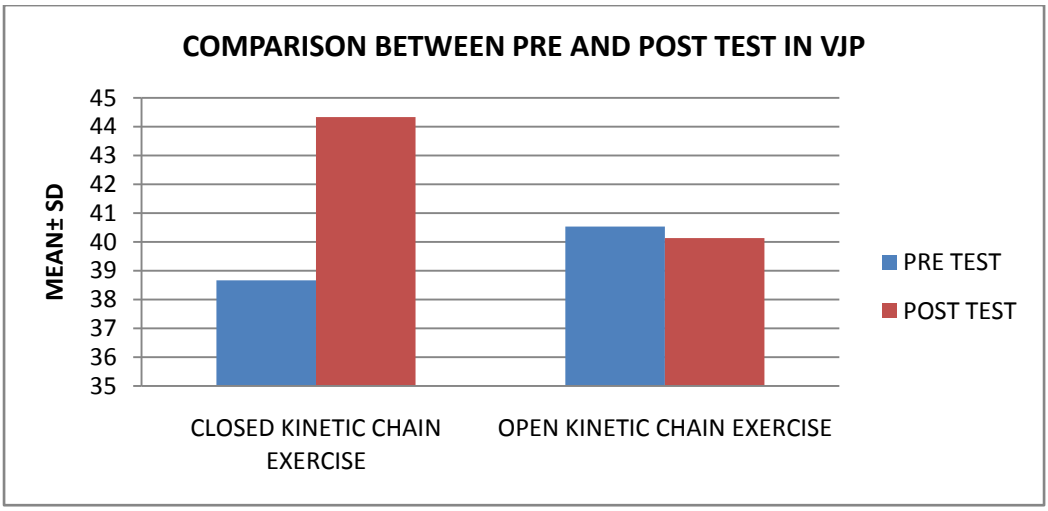
S_2 = Difference between pre test and post test of Control Group.

STATISTICAL ANALYSIS

TABLE: I

Mean & Standard deviation of vertical jump performance of Group A & Group B.

	Vertical Jump Performance	Mean	Standard deviation	F	Significance
Pre Test	Group A	38.67	2.610	1.190	0.285
	Group B	40.53	3.441		
Post Test	Group A	44.33	2.820	0.945	0.339
	Group B	40.13	5.553		



From the above results, it is observed that $p>0.05$, there is no statistically significant difference between closed kinetic chain exercise (Group A) & Open kinetic chain exercise (Group B) in vertical jump performance.

TABLE: II

Mean & Standard deviation of Right Gluteal 1 RM of Closed kinetic chain &Open kinetic chain

	Rt Gluteal I RM	Mean	Standard deviation	F	Significance
Pre Test	Closed Kinetic Chain	8.67	.900	.227	.637
	Open kinetic chain	9.27	.799		
Post Test	Closed Kinetic Chain	12.47	.915	9.403	.005
	Open kinetic chain	11.13	.2326		

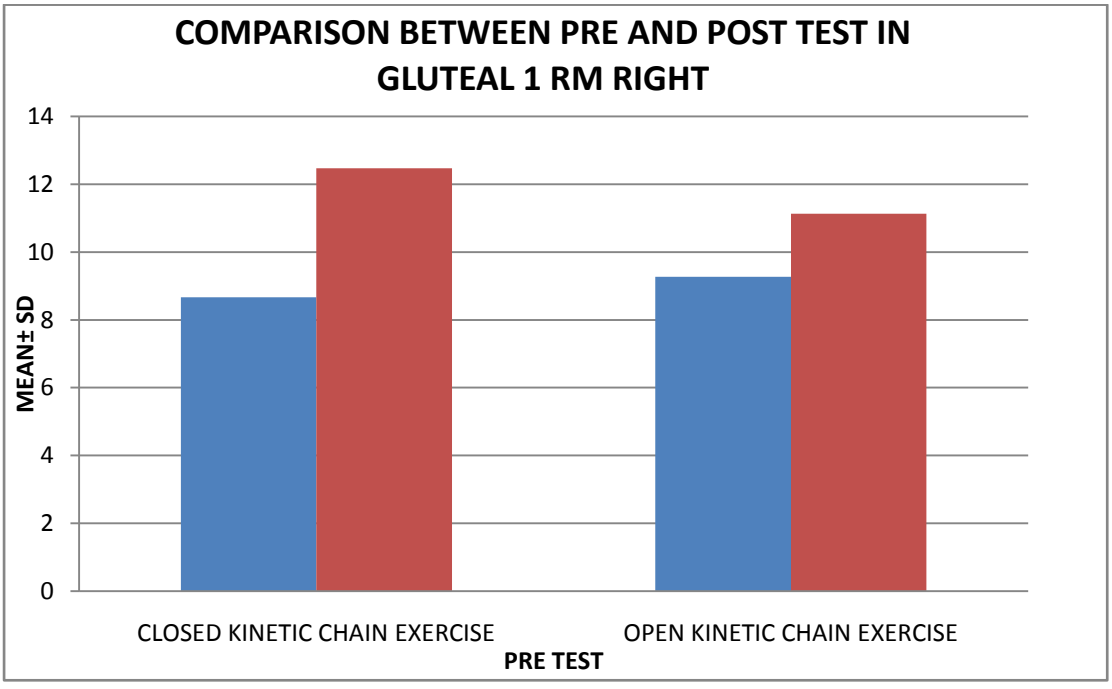
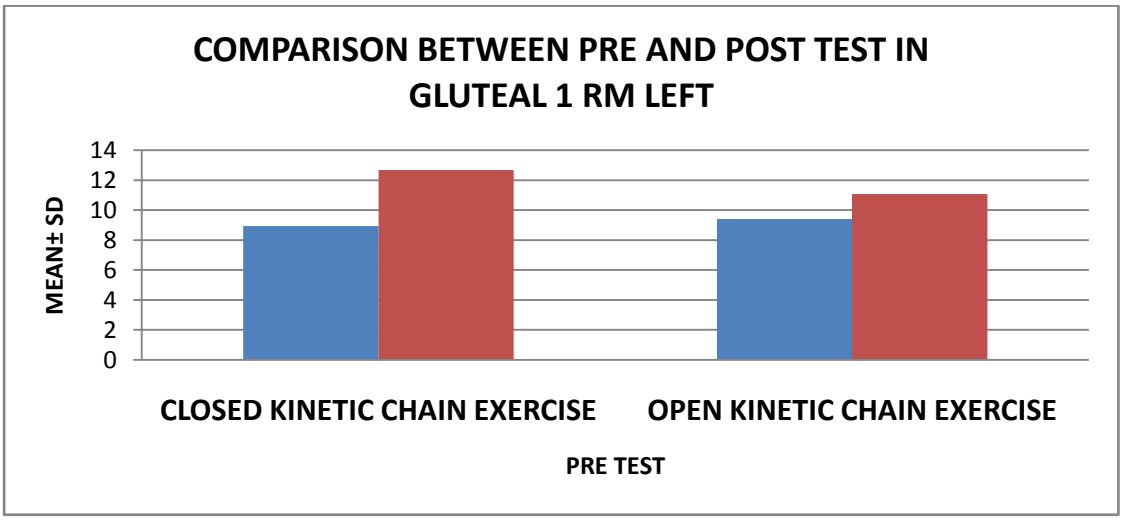


TABLE: III

Mean & Standard deviation of Left Gluteal 1RM of closed kinetic chain & Open kinetic chain

	Lf Gluteal I RM	Mean	Standard deviation	F	Significance
Pre Test	Closed Kinetic Chain	8.93	0.961	.436	.514
	Open kinetic chain	9.40	1.056		
Post Test	Closed Kinetic Chain	12.67	1.047	6.564	.016
	Open kinetic chain	11.07	2.492		



From the above results it is observed that $p<0.05$, and so there is statistically significant difference between closed kinetic chain exercise and open kinetic chain exercise in improving gluteal muscle strength.

TABLE: IV

Mean & Standard deviation of Right quadriceps 1 RM of Closed kinetic chain & Open kinetic chain.

	Rt quadriceps 1 RM	Mean	Standard deviation	F	Significance
Pre Test	Closed Kinetic Chain	10.33	.900	6.472	.017
	Open Kinetic Chain	10.33	.488		
Post Test	Closed Kinetic Chain	13.73	.704	45.087	.000
	Open Kinetic Chain	10.33	2.193		

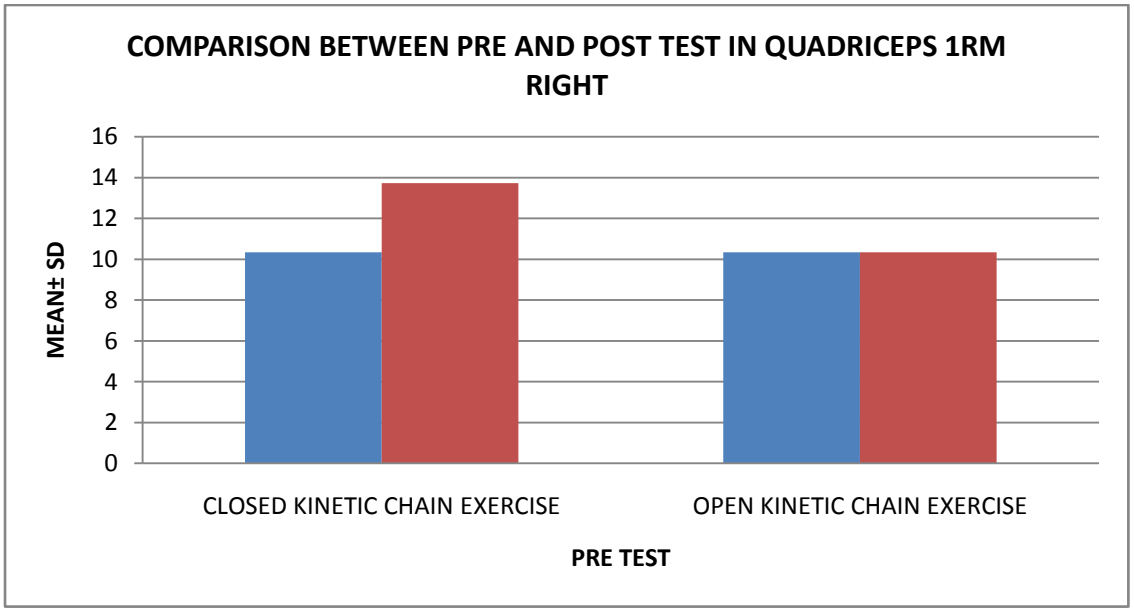
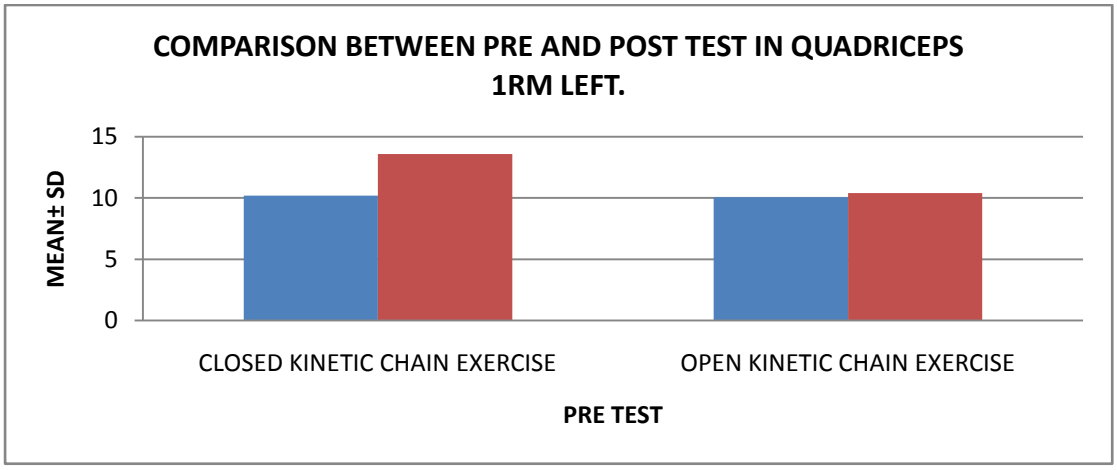


TABLE: V

Mean & Standard deviation of Left quadriceps 1 RM of Closed kinetic chain & Open kinetic chain.

	Lt quadriceps 1 RM	Mean	Standard deviation	F	Significance
Pre Test	Closed Kinetic Chain	10.20	.775	.118	.734
	Open Kinetic Chain	10.07	.704		
Post Test	Closed Kinetic Chain	13.60	.910	17.616	.000
	Open Kinetic Chain	10.40	1.844		



From the above results it is observed that $p<0.001$, and so there is statistically significant difference between closed kinetic chain exercise and open kinetic chain exercise in improving right and left quadriceps muscle strength.

CHPTER-V

5.1 RESULTS AND DISCUSSION

RESULTS:

According to table I the pre test mean value in vertical jump perform group A was38.67 and group B was 40.53 it shows P is lesser than 0.01 which shows statistically significant closed kinetic chain exercise group Aimproving the lower leg extensors muscle strength, and no statistically difference between the groups in vertical jump performance.

The post test was value in vertical jump perform group A was 44.33 and group B was 40.51 it shows P is lesser than 0.01 which shows statistically significant closed kinetic chain exercise group Aimproving the lower leg extensors muscle strength, and statistically difference between the groups in vertical jump performance.

According to table II the pre test mean values of right gluteal 1RM of closed kinetic chain exercise was 8.67 and open kinetic chain group B was 9.27, it shows that P is lesser than 0.05 which shows no statistically significant in closed kinetic chain exercise group A improving the gluteal muscle strength,

The post test mean value group A was 12.47 and group B was 11.13, it shows that P is lesser than 0.05 which shows statistically significant in right gluteal muscle strength.

According to table III the pre test mean values of left gluteal 1RM of closed kinetic chain exercise was 8.93 and group B was 9.40, it shows that P

is lesser than 0.05 which shows no statistically significant in closed kinetic chain exercise group Aimproving the left gluteal muscle strength.

The post test mean value group A was 12.67 and group B was 11.03, it shows that P is lesser than 0.05 which shows statistically significant in difference between closed kinetic chain exercise and open kinetic chain exercise in improving left gluteal muscle strength.

According to table IV the pre test mean values of right quadriceps 1RM of closed kinetic chain exercise was 10.33 and group B was 10.33, it shows that P is lesser than 0.01 which shows equal statistically significant in closed kinetic chain exercise group Aimproving the right extensors muscle strength,

The post test mean value group A was 13.73 and group B was 10.33, it shows that P is lesser than 0.05 which shows statistically significant in difference between closed kinetic chain exercise and open kinetic chain exercise in improving right gluteal muscle strength.

According to table IV the pre test mean values of right quadriceps 1RM of closed kinetic chain exercise was 10.33 and group B was 10.33, it shows that P is lesser than 0.01 which shows statistically significant in closed kinetic chain exercise group A improving the right extensors muscle strength,

The post test mean value group A was 13.73 and group B was 10.33, it shows that P is lesser than 0.05 which shows statistically significant in difference between closed kinetic chain exercise and open kinetic chain exercise in improving right quadriceps muscle strength.

According to table V the pre test mean values of left quadriceps 1RM of closed kinetic chain exercise was 10.20 and group B was 10.07, it shows

that P is lesser than 0.01 which shows statistically significant in closed kinetic chain exercise group Aimproving the left extensors muscle strength,

The post test mean value group A was 13.60 and group B was 10.40, it shows that P is lesser than 0.05 which shows statistically significant indifference between closed kinetic chain exercise and open kinetic chain exercise in improving leftquadriceps muscle strength.

Closed kinetic chain exercise has become popular rehabilitation due to the belief that it is more closely related to function than open kinetic chain exercise.this study purpose was to investigate the relationship between closed kinetic chain and open kinetic chain strength of the lower limb extensors vertical jumping performance. and gluteal and quadriceps muscle strength were measured at the baseline and 6 week of training programme.

The result of this study shows that the P value ofgroup A,is lesser than 0.009which shows 99.9% of significant and in group B, P value is lesser than 0.01 which shows 99% of significant. Hence it indicates study revealed statistically significant differences ($p<0.01$) closed kinetic chain exercise (Group A), than open kinetic chain exercise (Group B) in improving the lower leg extensors muscle strength.

5.1 DISCUSSION:

Blackborn and morrisey (1998) in their studies shows lower limb eztensor closed kinetic chain muscle strength is more highly related to jumping performance than knee extensor open kinetic chain and open kinetic chain exercises.

Misner et al in his study, female fire fights and are similar findings to Blackburn and Morrissey.

And similar findings have been noted when testing the relationship between closed kinetic chain strength of lower limb extensors and vertical jump performance by Ashley and weiss.

The consistent finding of a positive relationship between vertical jump performance and closed kinetic strength is not surprising, given the similar functional requirement of the lower extremities during the lifted stage of closed kinetic chain muscle strength testing and propulsive phase of jumping.

The co-efficient of determination values for the relationships both forms of jumping and the closed chain kinetic chain scores ranges from 28 to 33, this means there is approximately 50-60 % of variation in the values of jumping performance scores.

Controversy in this study there is no statistically significant difference between closed kinetic chain exercise and open kinetic chain exercise and open kinetic chain exercise in improving lower leg extensors muscle strength.

Areal difference in the correlations foe open kinetic chain and closed kinetic strength testing, the reason for this difference is the greater similarity in the movement between the closed kinetic chain test and propulsive phase of jumping.

The closed kinetic chain test assess the strength of two major muscle groups responsible for jumping propulsion; the knee and hip extensors, the open kinetic chain test used this study only assess the strength of knee extensors.

Teddy and worell showedafter a 4 week aggressive step up exercise protocol improved lower extremity performance as measured by closed kinetic chain activities, strength gains achieved during 4 weeks probably represented on increase in neural adaptation.

Mortani et al reported that neural factors were responsible for initial strength gains and that muscle hypertrophy become more dominant after first 3-5 weeks of training.

Based on the reviews, in this study also shoes positive correlation between closed kinetic chain in improving muscle strength than open kinetic chain strength.

During kinetic exercise there are typically two kinds of external forces: shear and compression.

Pinciveroet al found that closed kinetic chain exercise reduces shear force and increase knee stability. Similarly Escamilla ct al found that there was a large amount of quadriceps activity during both exercises.

Previous research comparing open kinetic chain closed kinetic chain exercise was safer more beneficial exercise for rehabilitation and strengthening.

However according to pincivero throughout the entire flexion, open kinetic chain stresses are not beyond normal physiological range nor significantly higher than closed kinetic chain exercise stresses.

Based on a review of data, both types exercise may be modified to minimize the risk of applying excessive strain on ligaments and joints. Depending on the functional goals of the individual. Both open kinetic chain exercise and closed kinetic chain exercise may be appropriate.

VI. CONCLUSION:

The study concluded that positive correlation of closed kinetic chain exercise is found to be effective and statistically significant in improving the gluteal and quadriceps muscle strength than open kinetic chain exercise. However both open and closed kinetic chain exercise has not been proved statistically significant in vertical jump.

The coefficient of determination values for the relationship between both forms of jumping and the closed kinetic chain score ranges approximately 0.7 testing and 0.1 for open kinetic chain testing. These coefficients were only statistically significant in closed kinetic chain testing.

VII. LIMITATIONS:

- Study was limited only to the male players.
- The sample selected was small sample.
- Compare the effects of sex difference.

VII (a) RECOMENTATIONS:

- This study suggests that to make study more valid a long term with or without increase in frequency of training is needed.
- Sample studied were small & study reduces the generalizability. Therefore study with a much larger population is recommended.
- Future research is needed to asses closed kinetic chain vs open kinetic chain muscle strength relationship to other functional activities in different population and more importantly, to determine possible training differences between these form of exercise.
- This study done only 18-25 years of age groups.

CHAPTER-VIII

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APPENDIX- I

ASSESSMENT FORM

Case No. :

Name :

Age :

Gender :

Occupation :

Address :

Date of Evaluation :

CHIEF COMPLAINTS

Present Medical History

- Mode onset
- Duration
- Associated Problem

Past Medical History

- History of other diseases & injuries
- Operation & hospitalization
- Medication
- Physiotherapy Treatment

Personal History

- Personal Habits

- Marital Status

Family History

- Similar problems in Relatives
- Hereditary Diseases
- Infection

Economic History

- Income
- Expenditure

Social History

- Social Status
- Educational Status

VITAL SIGNS

- Heart Rate
- Respiratory Rate
- Blood Pressure
- Temperature

ON OBSERVATION

- Body built
- Posture
- Gait
- Skin Color
- Deformity's
- Swelling
- Scar

ON PALPATION

- Tenderness
- Warmth
- Swelling
- Crepitus
- Pulses
- Spasm

ON EXAMINATION:

1RM test

Exercises	**Pre test**		**Post test**	
	RT	**LF**	**RT**	**LF**
Gluteal Open kinetic chain				
Gluteal Closed kinetic chain				
Quadriceps Open kinetic chain				
Quadriceps closed kinetic chain				

VERTICAL JUMP PERFORMANCE TEST

GROUPS	Pre test		Post test	
	RT	LF	RT	LF
GROUP A				
GROUP B				

Active Movements:

Knee joint ROM

Sitting: flexion:

Extension:

Special Test:

Differential diagnosis:

Diagnosis:

Treatment:

Problem List:

Physiotherapy Management

- **Aims**
- **Short term goal**
- **Long term goal**
- **Home Program**

APPENDIX- II

INFORMED CONSENT FORM

STATEMENT OF THE PARTICIPANT:

I _____ agree to take part in the research study, conducted by **Reg.No.271550081** Post graduate student (MPT SPORTS), Nandha college of physiotherapy entitled **"The relationship between open kinetic and closed kinetic chain exercise for lower limb extensor on jumping performance in collegiate basketball players"**

I acknowledge that the study has been explained to me and I understand that agreeing to participate in the study means that I am willing to,

I have been given opportunity to discuss and ask questions with the responsible physiotherapist regarding the study.

I have understood that there is no harm to my health by participating in the study period.

I will not under go any other training method during in this study.

I agree to participate voluntarily in this study described in this form.

Name of the participant: signature

Date:

If illiterate a literate witness must sign (if possible, this person should be selected by the participant and should have no connection to the research team). Participants who are illiterate should include their thumb-print as well.

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Name of the witness: signature

Date:

APPENDIX- III

DATA PRESENTATION

PRE AND POST TEST SCORES OF GROUP A

		PRE TEST					POST TEST			
S. No.	VIP (CMS)	GLUTIAL 1RM (WEIGHTS)		QUADRICEPS 1RM (WEIGHTS)		VIP (CMS)	GLUTIAL 1RM (WEIGHTS)		QUADRICEPS 1RM (WEIGHTS)	
		RT	LF	RT	LF		RT	LF	RT	LF
1	39	7	9	10	12	45	9	15	12	15
2	38	8	7	7	10	44	11	13	16	12
3	39	8	8	12	8	45	8	10	10	14
4	38	9	10	8	10	44	9	16	14	15
5	39	12	9	14	11	44	10	12	13	13
6	37	8	8	9	12	43	10	11	11	14
7	39	8	7	11	9	46	9	10	14	17
8	40	12	11	12	11	43	8	13	18	14
9	39	8	10	11	10	46	10	10	14	14
10	40	9	11	10	11	46	8	15	13	14
11	39	8	7	12	13	44	9	9	12	15
12	39	8	12	10	10	41	8	14	17	12
13	39	9	10	12	9	44	9	17	15	13
14	38	8	8	8	9	44	11	13	14	12
15	40	8	7	9	8	45	10	12	13	10
MEAN	38.7	8.67	8.93	10.33	10.20	44.33	9.27	12.67	13.7	13.6

DATA PRESENTATION

PRE AND POST TEST SCORES OF GROUP B

		PRE TEST					POST TEST			
S. No.	VIP (CMS)	GLUTIAL 1RM (WEIGHTS)		QUADRICEPS 1RM (WEIGHTS)		VIP (CMS)	GLUTIAL 1RM (WEIGHTS)		QUADRICEPS 1RM (WEIGHTS)	
		RT	LF	RT	LF		RT	LF	RT	LF
1	40	9	11	10	10	40	11	13	8	11
2	41	11	8	11	13	41	13	12	14	13
3	40	8	12	10	8	40	10	14	9	8
4	39	9	10	8	11	40	9	11	12	12
5	42	12	9	7	9	41	13	10	12	13
6	41	10	17	9	7	41	12	13	7	9
7	41	9	10	12	14	41.5	10	11	9	12
8	41	8	8	12	10	40	9	10	8	10
9	42	1	8	10	9	41	12	121	10	10
10	40	8	9	12	11	39	13	12	12	13
11	39	9	10	11	8	38	11	11	11	10
12	39	8	8	8	10	38	10	9	10	9
13	41	9	11	9	12	40	12	10	11	10
14	43	11	10	14	11	42	11	12	12	9
15	40	10	7	12	10	39	10	8	10	7
MEAN	40.4	9.27	9.40	10.33	10.7	40.6	11.13	11.7	10.33	10.40

ABSTRACT

The relationship between open kinetic and closed kinetic chai exercise for lower limb extensor on jumping performance in collegiate basketball players

BACKGROUND:

Closed kinetic chain exercise have been promoted as more functional and more appropriate than open kinetic chain exercises. Limited research exists demonstrating the effects of closed kinetic chain on gluteus, quadriceps and functional performance. Thus the purpose of the study was to investigate the relationship between open kinetic and closed kinetic chain exercise in improving functional performance and strength of lower limb extensors.

OBJECTIVES:

The study was compare to open kinetic and closed kinetic chain exercise in improving jumping performance in basketball players.

METERIALS & METHODS

PARTICIPANTS:

30 basketball players were randomly allocated into 2 groups, with age group between 18-25 years male collegiate athletes with mean age group of 121.76

DESING:

Experimental study design.

SETINGS:

Basketball ground, Nandha school campus.

SAMPLING:

Randomized sampling technique.

METHODOLOGY:

30 participants were included in the study and they were randomly allocated into two groups group A &group B.15 participants in group A were instructed to perform closed kinetic chain exercise for 30 sec with 15 repetitions. Rest period for 10 sec in between the each exercise. 15 participants in group B were instructed to perform open kinetic chain exercise for 30 sec with 15 participants. Rest period for 10 secs in between the each exercise. The participants were instructed to perform the above protocols for 6 weeks.

Vertical jump performance & lower leg muscle strength were measured for all these groups at the baseline before & at the end of 6 weeks after training programme.

OUTCOME MEASURES:

Vertical jump test: to measure vertical jump performance

One repetitive maximum: to measure the muscle strength

RESULTS:

Study revealed statistically significant differences ($p<0.01$) between closed kinetic chain exercise (Group A),open kinetic chain exercise (Group B) in improving the lower leg extensors muscle strength, and no statistically difference between the groups in vertical jump performance.

CONCLUSION:

Closed kinetic chain exercise (Group A) is more effective than open kinetic chain exercise (Group B) in improving the gluteal and quadriceps muscles strength, whereas there is no difference seen in vertical jump performance in between the two groups.

KEYWORDS:

Closed kinetic chain exercise exercise, vertical jump height,1RM